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(54) Title: IONOPHORE CONTAINING COMPOSITION FOR MODULATING AMYLOIDOSIS

(57) Abstract

Methods and compositions, useful in the treatment of amyloidosis and conditions and diseases associated therewith, such as Alzheimer's Disease (AD). These methods involve administering to a subject a pharmaceutical composition including one or more agents which modulate APP catabolism and amyloid deposition. Accordingly, the methods and compositions are useful for inhibiting amyloidosis in disorders in which amyloid deposition occurs. The methods are based, at least in part, on modulating catabolism of APP in APP–containing cells through the use of a mobile ionophore, such as carbonyl cyanide *p*–(trifluoromethoxy) phenylhydrazone, which does not substantially alter the viability of those cells.

IONOPHORE CONTAINING COMPOSITION FOR MODULATING AMYLOIDOSIS

Background of the Invention

Alzheimer's disease (AD) is a common dementing brain disorder of the elderly.
The key features of the disease include progressive memory impairment, loss of
language and visuospatial skills, and behavior deficits. These changes in cognitive
function are the result of degeneration of neurons in the cerebral cortex, hippocampus,
basal forebrain, and other regions of the brain. Neuropathological analyses of
postmortem Alzheimer's diseased brains consistently reveal the presence of large
numbers of neurofibrillary tangles in degenerated neurons and neuritic plaques in the
extracellular space and in the walls of the cerebral microvasculature. The neurofibrillary
tangles are composed of bundles of paired helical filaments containing
hyperphosphorylated *tau* protein (Lee, V. M and Trojanowski, J. Q, The disordered
Cytoskeleton in Alzheimer's disease, *Curr. Opin. Neurobiol.* 2:653 (1992)). The
neuritic plaques consist of deposits of proteinaceous material surrounding an amyloid
core (Selkoe, D. J., "Normal and abnormal biology of the β-amyloid precursor protein",
Annu. Rev. Neurosci. 17:489-517 (1994)).

Evidence suggests that deposition of amyloid-β peptide (Aβ) plays a significant
role in the etiology of Alzheimer's disease. A portion of this evidence is based upon
studies which have been generated from data with regard to familial Alzheimer's disease.
To date, this aggressive form of Alzheimer's disease has been shown to be caused by
missense mutations in (at least) three genes: the amyloid precursor protein (APP) gene
itself (Goate, A. *et al.*, "Segregation of a missense mutation in the amyloid precursor
protein gene with familial Alzheimer's disease", *Nature* 349:704-706 (1991) and Mullan,
M. *et al.*, "A pathogenic mutation for probable Alzheimer's disease in the APP gene at
the N-terminus of β-amyloid", *Nature Genet.* 1:345-347 (1992)), and two genes termed
presenilins 1 and 2 (Sherrington, R. *et al.*, "Cloning of a gene bearing missense
mutations in early-onset familial Alzheimer's disease", *Nature* 375:754-760 (1995) and
Rogaev, E. I. *et al.*, "Familial Alzheimer's disease in kindreds with missense mutations
in a gene on chromosome 1 related to the Alzheimer's disease type 3 gene", *Nature*

376:775-778 (1995)). The missense mutations in APP are located in the region of the protein where proteolytic cleavage normally occurs (see below), and expression of at least some of these mutants results in increased production of Aβ (Citron, M. *et al.*, "Mutation of the β-amyloid precursor protein in familial Alzheimer's disease increases β

5   -amyloid production", *Nature* 360:672-674 (1992), Cai, X-D. *et al.*, "Release of excess amyloid β protein from a mutant amyloid β protein precursor", *Science* 259:514-516 (1993) and Reaume, A. G. *et al.*, "Enhanced amyloidogenic processing of the beta-amyloid precursor protein in gene-targeted mice bearing the Swedish familial Alzheimer's disease mutations and a humanized Aβ sequence", *J. Biol. Chem.*

10   271:23380-23388 (1996)). Initial analyses of the structure of the presenilins have not suggested whether or not they might alter production of Aβ, however, recent data has indicated that these mutations cause an increase in Aβ secretion (Martins, R. N. *et al.*, "High levels of amyloid-β protein from S182 (Glu^{246}) familial Alzheimer's cells", 7:217-220 (1995) and Scheuner, D. *et al.*, "Secreted amyloid beta-protein similar to that

15   in the senile plaques of Alzheimer's disease is increased in vivo by presenilin 1 and 2 and APP mutations linked to familial Alzheimer's disease", *Nature Medicine* 2:864-870 (1996)). Thus, increased production of Aβ is associated with Alzheimer's disease. Corroborating evidence has been derived from at least two other sources. The first is that transgenic mice which express altered APP genes exhibit neuritic plaques and age-

20   dependent memory deficits (Games, D. *et al.*, "Alzheimer-type neuropathology in transgenic mice overexpressing V717F β-amyloid precursor protein", *Nature* 373:523-525 (1995); Masliah, E. *et al.*, "Comparison of neurodegenerative pathology in transgenic mice overexpressing V717F β-amyloid precursor protein and Alzheimer's disease", *J. Neurosci.* 16:5795-5811 (1996); Hsiao, K. *et al.*, "Correlative memory

25   deficits, Aβ elevation, and amyloid plaques in transgenic mice", *Science* 274:99-103 (1996)). The second piece of evidence comes from study of patients suffering from Down's syndrome, who develop amyloid plaques and other symptoms of Alzheimer's disease at an early age (Mann, D. M. A. and M. M. Esiri, "The pattern of acquisition of plaques and tangles in the brains of patients under 50 years of age with Down's

30   syndrome", *J. Neurol. Sci.* 89:169-179 (1989)). Because the APP gene is found on

chromosome 21, it has been hypothesized that the increased gene dosage which results
from the extra copy of this chromosome accounts for the early appearance of amyloid
plaques (Kang, J. *et al.*, "The precursor protein of Alzheimer's disease amyloid A4
protein resembles a cell-surface receptor", *Nature* 325:733-736 (1987); Tanzi, R. E. *et*
5   *al.*, "Amyloid β protein gene: cDNA, mRNA distribution and genetic linkage near the
Alzheimer locus", *Science* 235:880-884 (1987)). Taken together with the evidence
derived from cases of familial Alzheimer's disease, the current data suggests that genetic
alterations which result in an increase in Aβ production can induce Alzheimer's disease.
Accordingly, since Aβ deposition is an early and invariant event in Alzheimer's disease,
10 it is believed that treatment which reduces production of Aβ will be useful in the
treatment of this disease.

The principal component of the senile plaque is the 4 kDa β-amyloid peptide
(Aβ). Ranging between 39 and 43 amino acids in length, Aβ is formed by
endoproteolysis of APP. Alternative splicing generates several different isoforms of
15 APP; in neurons, the predominant isoform is of 695 amino acids in length (APP695).
As APP traverses the endoplasmic reticulum (ER) and *trans*-Golgi network (TGN), it
becomes N- and O-glycosylated and tyrosine-sulfated. Mature holoprotein can be
catabolized in several compartments to produce both non- and amyloidogenic APP
fragments.

20   APP is expressed and constitutively catabolized in most cells. The dominant
catabolic pathway appears to be cleavage of APP within the Aβ sequence by an enzyme
provisionally termed α-secretase, leading to release of a soluble ectodomain fragment
known as APPsα. In contrast to this non-amyloidogenic pathway, APP can also be
cleaved by unidentified enzymes known as β- and γ-secretase at the N- and C-termini of
25 the Aβ, respectively, followed by release of Aβ into the extracellular space. Several
different C-terminal fragments are produced as intermediates in APP catabolic
processing; of particular interest is the production of an intracellular an 12 kDa C-
terminal fragment (C100) which is produced following β-secretase activity and contains
the entire Aβ sequence.

Abundant evidence suggests that extracellular accumulation and deposition of A β is a central event in the etiology of AD. However, recent studies have also proposed that increased intracellular accumulation of Aβ or amyloid containing C-terminal fragments may play a role in the pathophysiology of AD. For example, overexpression

5   of APP harboring mutations which cause familial AD results in the increased intracellular accumulation of C100 in neuronal cultures and $A\beta_{42}$ in HEK 293 cells. Moreover, evidence suggests that intra- and extracellular Aβ are formed in distinct cellular pools in hippocampal neurons and that a common feature associated with two types of familial AD mutations in APP ('Swedish' and 'London') is an increased

10   intracellular accumulation of $A\beta_{42}$. Thus, based on these studies and earlier reports implicating extracellular Aβ accumulation in AD pathology, it appears that altered APP catabolism may be involved in disease progression.

Numerous studies have suggested that proteolytic cleavage of APP occurs within acidic compartments of the cell based on the inhibitory actions of agents which are

15   known to disrupt intracellular pH and/or acidic organelles. For example, exposure of cells to the monovalent ionophore, monensin, or high concentrations of ammonium chloride (NH_4Cl) been shown to decrease APP proteolytic processing accompanied by concomitant alterations in full-length cellular APP. Similarly, the vacuolar H^+-ATPase inhibitor bafilomycin A1 (baf A1) has been reported to produce alterations in APP

20   catabolism which are both cell-type and APP mutation specific. However, the ionophores noted above have been found to be toxic, unacceptably inhibit ATP formation, and alter cellular viability and endosomal and lysosomal function.

Thus, in view of the anticipated benefits of modulating APP catabolism as a treatment for diseases such as AD, compositions and methods for modulating APP

25   catabolism in APP-containing cells which do not substantially alter the viability of those cells, have been desired and are addressed by the present invention.

Summary of the Invention

This invention provides methods and compositions, which are useful in the

30   treatment of amyloidosis and conditions and diseases associated therewith, such as

Alzheimer's Disease (AD). The methods of the invention involve administering to a subject a pharmaceutical composition including one or more agents which modulate APP catabolism and ultimately, amyloid deposition. Accordingly, the methods and compositions of the invention are useful for inhibiting amyloidosis in disorders in which

5   amyloid deposition occurs. The methods of the invention can be used therapeutically to treat amyloidosis or can be used prophylactically in a subject susceptible to amyloidosis. The methods of the invention are based, at least in part, on modulating catabolism of APP in APP-containing cells through the use of a mobile ionophore, such as carbonyl cyanide *p*-(trifluoromethoxy) phenylhydrazone, which does not substantially alter the

10   viability of those cells. Therefore, the mobile ionophores disclosed herein can modulate amyloid deposition.

The present invention provides methods for modulating APP catabolism, by administering to APP-containing cells an amount of a mobile ionophore composition effective to modulate APP catabolism without substantially altering the viability of said

15   APP-containing cells. In one preferred embodiment, the modulation includes preventing or inhibiting the amyloid deposition.

The present invention also provides methods for treating a disease state associated with amyloidosis by administering to a subject having APP-containing cells a pharmaceutically effective amount of a mobile ionophore composition effective to

20   modulate APP catabolism without substantially altering the viability of the APP-containing cells. In one preferred embodiment, the disease state associated with amyloidosis is associated with Alzheimer's Disease.

The present invention further pertains to packaged pharmaceutical compositions for treating a disease state associated with amyloidosis. The package includes a

25   container for holding an effective amount of a pharmaceutical composition and instructions for using the pharmaceutical composition for treatment of amyloidosis. The pharmaceutical composition includes a mobile ionophore composition effective to modulate APP catabolism in APP-containing cells. In one preferred embodiment, the packaged pharmaceutical composition is for treatment associated with Alzheimer's

30   Disease.

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The present invention further pertains to pharmaceutical compositions for treating amyloidosis, including a therapeutically effective amount of a mobile ionophore composition effective to modulate APP catabolism in APP-containing cells without substantially altering the viability of the APP-containing cells, and a pharmaceutically
5   acceptable vehicle.

The present invention further pertains to methods for modulating amyloid deposition in a subject, including administering to a subject having APP-containing cells an effective amount of a mobile ionophore composition effective to modulate APP catabolism without substantially altering the viability of the APP-containing cells, such
10   that modulation of amyloid deposition occurs.

Brief Description of the Drawings

FIG. 1 generally illustrates APP catabolism.

15   FIG. 2 illustrates FCCP reduction of Aβ release from mutant APP at 30 minutes in K695sw cells.

FIG. 3 illustrates FCCP reduction of Aβ release from mutant APP at 4 hours in K695sw cells.
20

FIG. 4 illustrates FCCP inhibition of wild-type APP in K695 cells.

FIG. 5 illustrates FCCP effect on cellular ATP levels.

25   FIG. 6 illustrates the lack of toxicity of FCCP on K695sw cells.

FIG. 7 shows a comparison of the effects of FCCP to baf A1 and NH₄Cl on the endosomal/lysosomal function of K695sw cells.

Detailed Description of the Invention

The present invention pertains to methods for modulating APP catabolism via the use of mobile ionophore compositions to modulate APP catabolism in APP-containing cells without substantially altering the viability of those cells. Modulation of,

5   e.g., reducing, APP catabolism, results in a decreased production of amyloid-ß protein (Aß) or increasing production of soluble amyloid precursor protein (APP$_s$), which are associated with amyloidosis and conditions related thereto, such as Alzheimer's disease.

The term "alkyl" refers to the radical of saturated aliphatic groups, including straight-chain alkyl groups, branched-chain alkyl groups, cycloalkyl (alicyclic) groups,

10 alkyl substituted cycloalkyl groups, and cycloalkyl substituted alkyl groups. In one embodiment, a straight chain or branched chain alkyl has 30 or fewer carbon atoms in its backbone (e.g., C_1-C_{30} for straight chain, C_3-C_{30} for branched chain), and more preferably 20 or fewer. Likewise, cycloalkyls have from 4-10 carbon atoms in their ring structure, and more preferably have 5, 6 or 7 carbons in the ring structure.

15 Moreover, the term alkyl as used throughout the specification and claims is intended to include both "unsubstituted alkyls" and "substituted alkyls", the latter of which refers to alkyl moieties having substituents replacing a hydrogen on one or more carbons of the hydrocarbon backbone. Such substituents can include, for example, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxy alkoxycarbonyloxy,

20 aryloxycarbonyloxy, carboxylate, alkylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonato, phosphinato, cyano, amino (including alkyl amino, dialkylamino, arylamino, diarylamino, and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, sulfonato,

25 sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, aralkyl, or an aromatic or heteroaromatic moiety. It will be understood by those skilled in the art that the moieties substituted on the hydrocarbon chain can themselves be substituted, if appropriate. Cycloalkyls can be further substituted, e.g., with the substituents described above. An "aralkyl" moiety is an alkyl substituted with an aryl (e.g., phenylmethyl

30 (benzyl)).

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The term "aryl" as used herein includes 5- and 6-membered single-ring aromatic groups that may include from zero to four heteroatoms, for example, benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole, pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, and the like. Aryl groups also include polycyclic fused

5   aromatic groups such as naphthyl, quinolyl, indolyl, and the like. Those aryl groups having heteroatoms in the ring structure may also be referred to as "aryl heterocycles", "heteroaryls" or "heteroaromatics". The aromatic ring can be substituted at one or more ring positions with such substituents as described above, as for example, halogen, hydroxyl, alkoxy, alkylcarbonyloxy, arylcarbonyloxy, alkoxycarbonyloxy,

10 aryloxycarbonyloxy, carboxylate, alkylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonato, phosphinato, cyano, amino (including alkyl amino, dialkylamino, arylamino, diarylamino, and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, sulfonato,

15 sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, aralkyl, or an aromatic or heteroaromatic moiety. Aryl groups can also be fused or bridged with alicyclic or heterocyclic rings which are not aromatic so as to form a polycycle (e.g., tetralin).

Unless the number of carbons is otherwise specified, "lower alkyl" as used herein

20 means an alkyl group, as defined above, but having from one to ten carbons, more preferably from one to six carbon atoms in its backbone structure. Preferred alkyl groups are lower alkyls having one to three carbon atoms.

The terms "heterocyclyl" or "heterocyclic group" refer to 3- to 10-membered ring structures, more preferably 4- to 7-membered rings, which ring structures include one to

25 four heteroatoms. Heterocyclyl groups include pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine, morpholine, lactones, lactams such as azetidinones and pyrrolidinones, lactones, sultams, sultones, and the like. The heterocyclic ring can be substituted at one or more positions with such substituents as described above, as for example, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxycarbonyloxy,

30 aryloxycarbonyloxy, carboxylate, alkylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonato, phosphinato, cyano, amino

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(including alkyl amino, dialkylamino, arylamino, diarylamino, and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, aralkyl, or an

5   aromatic or heteroaromatic moiety. A heteroalkyl moiety is an alkyl substituted with a heteroaromatic group.

       The terms "polycyclyl" or "polycyclic group" refer to two or more cyclic rings (e.g., cycloalkyls, cycloalkenyls, cycloalkynyls, aryls and/or heterocyclyls) in which two or more carbons are common to two adjoining rings, e.g., the rings are "fused rings".

10   Rings that are joined through non-adjacent atoms are termed "bridged" rings. Each of the rings of the polycycle can be substituted with such substituents as described above, as for example, halogen, hydroxyl, alkylcarbonyloxy, arylcarbonyloxy, alkoxycarbonyloxy, aryloxycarbonyloxy, carboxylate, alkylcarbonyl, alkoxycarbonyl, aminocarbonyl, alkylthiocarbonyl, alkoxyl, phosphate, phosphonato, phosphinato,

15   cyano, amino (including alkyl amino, dialkylamino, arylamino, diarylamino, and alkylarylamino), acylamino (including alkylcarbonylamino, arylcarbonylamino, carbamoyl and ureido), amidino, imino, sulfhydryl, alkylthio, arylthio, thiocarboxylate, sulfates, sulfonato, sulfamoyl, sulfonamido, nitro, trifluoromethyl, cyano, azido, heterocyclyl, alkyl, aralkyl, or an aromatic or heteroaromatic moiety.

20   The language "modulation of amyloid deposition" as used herein, means that amyloid deposition is prevented or decreased, e.g. Aß deposition. This modulation can be by one or more chemically induced physiological mechanisms. For example, the mobile ionophore compositions of the present invention can modulate amyloidosis in a subject such as by modulating APP catabolism, thereby decreasing production of

25   amyloid-ß protein (Aß) or increasing production of soluble amyloid precursor protein (APP_S).

       The language "modulation of APP catabolism" as used herein, means that APP catabolism is prevented or decreased. This modulation can be by one or more chemically induced physiological mechanisms. For example, the dominant catabolic

30   pathway appears to be cleavage of APP within the Aβ sequence by an enzyme provisionally termed α-secretase, leading to release of a soluble ectodomain fragment

known as APPsα. In contrast to this non-amyloidogenic pathway, APP can also be cleaved by unidentified enzymes known as β- and γ-secretase at the N- and C-termini of the Aβ, respectively, followed by release of Aβ into the extracellular space. Several different C-terminal fragments are produced as intermediates in APP catabolic

5   processing; such as the production of an intracellular an 12 kDa C-terminal fragment (C100) which is produced following β-secretase activity and contains the entire Aβ sequence.

The term "subject" is intended to include mammals having amyloid deposition, including one or more amyloid-related symptoms, or which are susceptible to amyloid

10 deposition. Examples of such subjects include humans, dogs, cats, pigs, cows, horses, rats and mice.

The term "mobile ionophore composition" is intended to refer to compositions which disrupt intracellular pH, as is believed to be important in the present disclosure, e.g., uncouplers of oxidative phosphorylation. The mobile ionophore compositions of

15 the present invention have the effect of modulating APP catabolism in APP-containing cells without substantially altering the viability of those cells. In an advantageous embodiment, the mobile ionophore compositions are of the formula

$$[Y-]-NH-[-Z] \qquad (I)$$
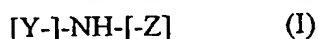
wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H or an

20 electron-withdrawing moiety; provided that when Z is H, Y further comprises an electron-withdrawing moiety thereon.

"Hydrophobic/lipophilic moiety" is intended to refer to moieties which are hydrophobic and/or lipophilic in nature. Advantageously, such moieties allow the mobile ionophore to position itself within the lipid bilayer of a cell membrane such that

25 the mobile ionophore composition functions as, e.g., a protonophore, so as to conduct protons across the membrane.

Examples of hydrophobic/lipophilic moieties include aryl, aralkyl, aryl heterocycles, polycycyls, and heterocyclyls, such as benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole, pyrazole, pyridine, pyrazine, pyridazine and

30 pyrimidine, naphthyl, quinolyl, indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole,

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piperidine, piperazine, morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones. A preferred hydrophobic/lipophilic moiety is benzyl.

"Electron-withdrawing moiety" is intended to refer to moieties which are electron-withdrawing in nature, such as chemical groups associated with a relatively

5   high electronegativity, like halogen atoms (e.g., fluorine or chlorine), or mono-, di-, or tri- halosubstituted, alkyl, alkylsulfonyl, or alkoxy groups. Examples of these groups include carbonyl cyano, trifluoromethanesulfonyl, trifluoromethoxy, and trifluoroethoxy. The presence of such electron-withdrawing moieties on preferred mobile ionophores disclosed herein is believed to enhance their properties as

10 protonophores. In particular, the electron-withdrawing moiety(s) are believed to promote the protonization/deprotonization capability of the nitrogen atom in formula (I), which is believed to be important to the actions of the molecule *in vivo*. The presence of more than one electron-withdrawing moiety on the molecule is believed to be particularly advantageous; for example, in the above formula (I), in embodiments where

15 Z is an electron-withdrawing moiety, the Y hydrophobic/lipophilic moiety may be substituted with one or more electron-withdrawing moieties, e.g., a *p*-substituted aryl group. Particularly preferred electron-withdrawing groups are trifluoromethanesulfonyl, trifluoromethoxy, trifluoroethoxy, and carbonyl cyano groups.

In another embodiment the mobile ionophore composition is of the formula:
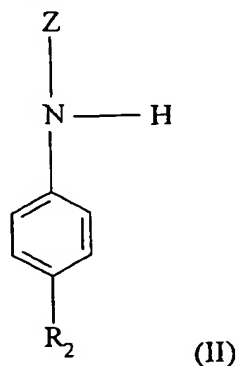
$$
\begin{array}{c}
Z \\
| \\
N \!-\!\!-\! H \\
\end{array}
$$

20

(II)

wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety. In a preferred embodiment Z and R_2 are electron-withdrawing moieties.

Desirably, Z and R_2 are electron-withdrawing moieties, which may be, e.g., trifluoromethanesulfonyl, trifluoromethoxy, trifluoroethoxy, or carbonyl cyano groups. Desirably, R_2 is an alkoxy group which contains one or more halogen atoms thereon, such as a mono-, di-, or tri- halomethoxy group. In another embodiment R_2 is a

5   trifluoromethoxy group and Z is -NC(CN)$_2$. In yet another embodiment, Z is -SO$_2$R$_4$ where R_4 is a mono-, di- or tri- halomethyl group.

Preferred mobile ionophore compositions include carbonyl cyanide p-(trifluoromethoxy) phenylhydrazone, carbonyl cyanide m-chlorophenylhydrazone, N[4-(tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-chlorophenyl]-

10   1,1,1-trifluoromethanesulfonamide, N-[4-(tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-(methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-(t-butyl)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-fluorophenyl]-1,1,1-trifluoromethanesulfonamide, N-phenyl-1,1,1-trifluoromethanesulfonamide, N-[4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide,

15   N-[4-(N,N-dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-cyanophenyl]-1,1,1-trifluoromethanesulfonamide, and N-[4-(methylsulfonyl)phenyl]-1,1,1-trifluoromethanesulfonamide.

The term "administering" is intended to include routes of administration which allow the mobile ionophore composition to perform its intended function, e.g.,

20   preventing or inhibiting amyloidosis. A variety of routes of administration are possible including, but not necessarily limited to parenteral (e.g., intravenous, intraarterial, intramuscular, subcutaneous injection), oral (e.g., dietary), topical, nasal, rectal, or via slow releasing microcarriers depending on the disease or condition to be treated. Oral, parenteral and intravenous administration are preferred modes of administration.

25   Formulation of the compound to be administered will vary according to the route of administration selected (e.g., solution, emulsion, gels, aerosols, capsule). An appropriate composition comprising the compound to be administered can be prepared in a physiologically acceptable vehicle or carrier and optional adjuvants and preservatives. For solutions or emulsions, suitable carriers include, for example,

30   aqueous or alcoholic/aqueous solutions, emulsions or suspensions, including saline and buffered media, sterile water, creams, ointments, lotions, oils, pastes and solid carriers.

Parenteral vehicles can include sodium chloride solution, Ringer's dextrose, dextrose and sodium chloride, lactated Ringer's or fixed oils. Intravenous vehicles can include various additives, preservatives, or fluid, nutrient or electrolyte replenishers (See, generally, Remington's Pharmaceutical Science, 16th Edition, Mack, Ed. (1980)).

5   The language "effective amount" is that amount of the mobile ionophore composition which allows it to perform its intended function. For example, an effective amount is that amount sufficient to inhibit, partially or totally, APP catabolism and thus prevent or reduce further amyloid deposition. The "effective amount" also includes the amount sufficient to treat amyloidosis or Alzheimer's disease. The effective amount will

10   depend upon a number of factors, including biological activity of the mobile ionophore composition, age, body weight, sex, general health, severity of the disease to be treated, as well as appropriate pharmacokinetic properties. For example, dosages of the active substance may be from about 0.01 mg/kg/day to about 500 mg/kg/day, advantageously from about 0.1 mg/kg/day to about 100 mg/kg/day. A therapeutically effective amount

15   of the active substance can be administered by an appropriate route in a single dose or multiple doses. Further, the dosages of the active substance can be proportionally increased or decreased as indicated by the exigencies of the therapeutic or prophylactic situation.

The term "amyloidosis" is art recognized and is intended to include amyloid

20   deposition related symptoms, such as progressive and undesirable memory impairment, loss of language and visuospatial skills, and behavior deficits. These changes in cognitive function are the result of degeneration of neurons in the cerebral cortex, hippocampus, basal forebrain, and other regions of the brain. The presence of large numbers of neurofibrillary tangles in degenerated neurons, neuritic plaques in the

25   extracellular space and in the walls of the cerebral microvasculature are a result of amyloid deposition. For example, neuritic plaques which consist of deposits of proteinaceous material surrounding an amyloid core

The present invention further pertains to packaged pharmaceutical compositions for treating amyloidosis. The package includes a container for holding an effective

30   amount of a pharmaceutical composition and instructions for using the pharmaceutical

composition for treatment of amyloidosis. The pharmaceutical composition includes at least one mobile ionophore composition for modulating APP catabolism in a subject.

The term "pharmaceutical composition" includes mobile ionophore compositions of the present invention and includes ingredients, such as other therapeutically active substances, inert ingredients, and carrier compounds. The components of the composition must be compatible, meaning that the components must be capable of being commingled with the active substance, e.g., the mobile ionophore composition, and with each other in a manner such that there is no interaction which would substantially reduce during use the composition's efficacy for modulating amyloid deposition.

The pharmaceutical compositions can be prepared by known procedures using well known and readily available ingredients. In making the pharmaceutical compositions of the present invention, the active substance will usually be admixed with a carrier, or diluted by a carrier, or enclosed within a carrier which may be in the form of a capsule, sachet, paper or other container. When the carrier serves as a diluent, it may be a solid, semi-solid or liquid material which acts as a vehicle, excipient or medium for the active ingredient. Thus, the compositions can be in the form of tablets, pills, powders, lozenges, sachets, cachets, elixirs, suspensions, emulsions, solutions, syrups, aerosols, (as a solid or in a liquid medium), ointments containing up to 10% by weight of the active compound, soft and hard gelatin capsules, packaged powders, and the like. Examples of suitable carriers, excipients, and diluents are lactose, dextrose, sucrose, sorbitol, mannitol, starches, gumacacia, calcium phosphate, alginates, tragacanth, gelatin, calcium silicate, microcrystalline cellulose, polyvinylpyrrolidone, cellulose, water syrup, methyl cellulose, methylhydroxybenzoates, propylhydroxybenzoates, propylhydroxybenzoates, talc, and other compounds as are well known to those skilled in the pharmaceutical arts.

The term "organism" is intended to include single cells, such as *C. elegans*, multicell organisms, such as yeast, and cell lines. Multicell organisms include small mammals, such as mice, rats, guinea pigs, and pigs that can develop amyloidosis.

The term "model system" includes cells, cell lines and mammals, such as mice, rats and pigs.

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The invention is further illustrated by the following exemplification which in no way should be construed as being further limiting. The contents of all references, pending patent applications and published patent applications, cited throughout this application are hereby incorporated by reference. It should be understood that the

5   animal cell line model(s) used throughout the examples are accepted cell models and that the demonstration of efficacy in these cell models is predictive of efficacy in humans.

Exemplification

10 *Cell Lines and Drug Treatments*

Human embryonic kidney (HEK) 293 cells stably transfected with either wild-type APP_{695} (K695 cells) or APP carrying the AD-linked double "Swedish" mutation (K695sw cells)(30) were cultured in DMEM supplemented with sodium pyruvate (1 mM) and 10% fetal calf serum as previously described (31). Cells were plated at

15 1,000,000 cells per well in 35 mm^2 culture dishes (Corning™) 24 hours prior to drug exposure. Preceding the addition of drugs, cultures are washed once with warm PBS (37°C) and then exposed to various treatments in DMEM supplemented with sodium pyruvate (1 mM). Cultures were then exposed to either control media, vehicle (0.05% ethanol), or varying concentrations of FCCP (5 µM, 500 nM, 50 nM). Either 30 minutes

20 or 4 hours after the addition of drugs, the media was removed, the cultures washed once with ice-cold PBS, and then harvested in 100 µl of ice-cold lysis buffer containing 20 mM MOPS (pH 7.2), 5 mM EDTA, 0.01% NP-40, 75 mM β-glycerol phosphate, 200 mM DTT, 100 mM sodium vanadate, 50 mM phosphatase substrate, 100 mM PMSF, and 1 mg/ml each of leupeptin, aprotinin and pepstatin.

25 *Detection of Intra- and Extracellular APP Catabolic Fragments*

To examine extracellular APP fragments, the media was retained and centrifuged at 4°C for 10 min at 16,000 X g to remove cellular debris. Extracellular protein was then precipitated by 10% trichloroacetic acid as previously described (31). Subsequently, secreted APPsα was determined by 10 % Tris-Glycine SDS-PAGE Western Blot

30 analysis using the monoclonal antibody WO-2, generated against the first 16 amino

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acids of the N-terminal region of Aβ (32). Similarly, extracellular Aβ release was examined by 16% Tris-Tricine SDS-PAGE Western Blot analysis using the WO-2 antibody (32). For examination of intracellular APP fragments, cultures were harvested in ice-cold lysis buffer and then sonicated for 8 seconds on ice. Cellular protein levels

5   were quantified using the BCA protein assay (Pierce, Rockford, IL) and 10 μg of cellular protein were then separated by either 10% Tris-Glycine or 16% Tris-Tricine SDS-PAGE. Intracellular C100 and total APP were quantitated, respectively, by 16 % Tris-Tricine Western Blot analysis using the WO-2 antibody and 10% Tris-Glycine Western Blot analysis using an anti-APP N-terminal antibody (22C11, Boehringer

10   Mannheim, Laval, QC). A diagram of the catabolic fragments of APP and the epitopes to which each antibody binds is depicted in FIG. 1. As seen in FIG. 1, the N-terminus of APP is extracellular, the C-terminus is intracellular. The wavy line represents the plasma membrane. The enzyme α-secretase (α-left) cleaves APP within the Aβ sequence (represented by the heavy line), resulting in release of the ectodomain

15   fragment known as APPsα. The enzymes β and γ secretase (β, γ, right) sequentially cleave APP on either side of the Aβ sequence. β secretase cleavage results in the release of the ectodomain fragment known as APPsβ and production of the cellular fragment known as C100; following γ-secretase cleavage, extracellular Aβ is released. Probing the cellular fraction with antibody 22C11 identifies total cellular APP. Probing the

20   cellular fraction with WO-2 identifies C100 (distinguished by molecular weight). Probing the extracellular fraction with WO-2 identifies both APPsα and Aβ (distinguished by molecular weight).

Cellular (C100 and total APP) and extracellular (APPsα and Aβ) APP catabolic fragments were separated using SDS PAGE with either 10% Tris-Glycine (for APPsα

25   and total APP) or 16% Tris-Tricine (for C100 and Aβ) gels. Following electrophoretic separation, proteins were transferred to nitrocellulose membranes and probed with either the monoclonal antibody WO-2 to detect C100, APPsα and Aβ, or 22C11 to detect total cellular APP. Immunoreactive bands were visualized using ECL detection (Amersham, Oakville, ON) and analyzed by standard autoradiographic and densitometric techniques

30   as described (31).

Quantification of Cellular ATP Levels

K659sw cells were maintained, exposed to drugs, and harvested as described above with the exception that cells were plated at 500,000 cells per plate and the lysis buffer used consisted of 25 mM Tricine (pH 7.8), 270 mM sucrose and 1 mM EDTA.

5   After harvesting, samples were centrifuged at 4°C for 10 min at 16,000 X g to remove cellular debris. 20 μl aliqouts of ATP standards and samples were then assayed for ATP content using a luciferase/luciferin ATP determination kit (A-6608, Molecular Probes, Eugene, OR). ATP-dependent luminescence was quantified using an Optocomp® II luminometer (MGM Instruments, Hamden, CT) and ATP levels were determined by

10   extrapolation from a standard curve. Cellular protein levels were quantified using the BCA protein assay (Pierce, Rockford, IL) and cellular ATP levels were expressed as mol/g protein. As a positive control, the effect of combined treatment with various concentrations of sodium azide and 2-deoxy-D-glucose (NaA/DG) was also examined in these studies.

15   *Assessment of Cell Viability*

Cell viability was quantified based on the exclusion of the membrane impermeant probe, YO-PRO (Molecular Probes, Eugene, OR). K695sw cells were maintained and exposed to vehicle or various concentrations of FCCP as described above with the exception that cells were plated at a density of 20,000 cells/well in 96-

20   well plates (Falcon®). Twenty-four hours after plating, cells were exposed to various treatments in DMEM supplemented with sodium pyruvate (1 mM) and 10% fetal bovine serum. At the same time as drug exposures, YO-PRO (4 μM) was added to each well and its uptake quantified every 30 minutes for 1 day at 37°C using a Cytofluor™ 2350 fluorometric plate reader (Millipore, Mississauga, ON). As a positive control, all wells

25   were exposed to 0.1% Triton X-100 at the end of the experiment.

Quantitation and Visualization of Endosomal and Lysosomal Function

Endosomal function was assessed by the fluorometric quantitation of the receptor-mediated uptake of both Texas Red and fluoroscein labelled transferrin (Molecular Probes, Eugene, OR)(33-35). K695 cells were maintained as exposed to

30   various treatments as mentioned with the exception that cells were plated at a density

200,000 cells/well in 24-well plates (Corning™). Twenty-four hours after plating, cells

were exposed to various treatments in DMEM supplemented with sodium pyruvate (1

mM) and 10% fetal bovine serum. At the same time as drug exposures, both

transferrin-Texas Red (Tf-Tx) and transferrin-fluoroscein (Tf-F) (10 µl/ml media of 5

5   mg/ml stocks in PBS) were added to each well and incubated for 4 hours at 37°C. Each

well was then gently washed three times with warm media and uptake of fluorescent

probes quantitated at 37°C using a Cytofluor™ 2350 fluorometric plate reader

(Millipore, Mississauga, ON). Quantitation of the non-pH-dependent Tf-Tx

fluorescence and the pH-dependent Tf-F fluorescence was determined using excitation

10   filters of 590 nm (bandwidth = 20nm); 485 nm (bandwidth = 20 nm) and emission filters

of 645 nm (bandwidth = 40 nm); 530 nm (bandwidth = 25 nm), respectively. Similarly,

Lysosomal function was assayed by the uptake of the fluorescent probe, Lysosensor™

Yellow/Blue DND-160 (Molecular Probes, Eugene, OR)(36). Assay of Lysosensor™

uptake was performed in an identical manner to that of the fluorescent labelled

15   transferrin conjugates with the exception that the addition of 10 µl/ml media of

Lysosensor™ was taken from a 1 mM stock solution in DMSO. Quantitation of the

non-pH-dependent blue fluorescence and the pH-dependent yellow fluorescence was

determined using an excitation filter of 360 nm (bandwidth = 40nm) and emission filters

of 460 nm (bandwidth = 40 nm) and 530 nm (bandwidth = 25 nm), respectively. For all

20   three probes examined, relative fluorescence was obtained from subtraction from sister

wells which had not been exposed to fluorophores. Exposure of wells minus cells to

probes and subsequent washing produced a similar signal as that observed from cellular

autofluorescence. As positive controls in both transferrin and Lysosensor™ uptake

experiments, sister wells were exposed to the agents, baf A1 (1 µM) and NH₄Cl (20

25   mM), which are known to affect acidic cellular compartments.

For the direct visualization of the cellular distribution of the Tf-Tx, Tf-F and

Lysosensor™ probes, K695 cells were grown, treated and exposed to fluorophores as

above with the exception that cells were plated in 35 mm plates (Corning™) at a density

of 750,000 cells/dish. Cultures were visualized and photographed through a water

immersion lense (63x magnification) using an Axiophot® fluorescent Microscope (Zeiss, Germany) with the same excitation and emission filters as mentioned above.

Statistical Analysis

Statistical significance was determined using an ANOVA with Tukey's *post hoc*

5   analysis. Data are expressed as mean ± SEM with * $p < 0.05$. Sequential Western Blots are representative of between 3 and 5 separate samples which may or may not have been taken from the same trial. n = 4 - 8 for each treatment group in experiments quantitating cellular ATP levels, cell viability and endosomal/lysosomal function.

10   **Results**

FCCP Inhibits APP Catabolism but not Maturation

We began our study using HEK 293 cells stably transfected with APP bearing the 'Swedish' mutation (K695sw cells), as detection of APP fragments is relatively straightforward in this cell line (30). Exposure of K695sw cells to the protonophore

15   FCCP for 30 min resulted in a concentration-dependent decrease in Aβ release. FIG. 2 illlustrates the effect of FCCP exposure to K695 cells at various concentrations for 30 minutes and cellular and released APP catabolic fragments quantified by Western blot analysis. The effect of FCCP on A) Aβ release, B) cellular C100, C) APPsα release and D), total cellular APP are illustrated. In D) solid, white and hatched bars represent total,

20   mature and immature APP, respectively. Data represent mean ± SEM with * $p < 0.05$.

Following 4 hours of FCCP treatment, decreases in Aβ release were even more pronounced, and in addition there was a concentration-dependent decrease in the formation of the C100 fragment (Figs. 3A, B). Production of the ectodomain fragment APPsα was only affected by 4 hour exposure to 5 μM FCCP, the highest concentration

25   employed (Fig. 3C), while neither total cellular levels of APP nor the maturation of APP via N'/O' linked glycosylation were affected by FCCP (Fig. 3D). FIG. 3 illlustrates the effect of FCCP exposure at various concentrations for 4 hours and cellular and released APP catabolic fragments quantified by Western blot analysis. The effect of FCCP on A) Aβ release, B) cellular C100, C) APPsα release and D), total cellular APP are

illustrated. In D) solid, white and hatched bars represent total, mature and immature

APP, respectively. Data represent mean ± SEM with * p < 0.05.

     In previous studies it was shown that the proton-ATPase inhibitor, baf A1,

reduced Aβ production in K695sw cells but not in cells expressing wild-type APP. As

5   both baf A1 and FCCP may act on acidic compartments, albeit via different

mechanisms, we tested the effects of FCCP upon APP catabolism in HEK 293 cells

stably transfected with wild-type APP$_{695}$ (K695 cells) (Fig. 4). In contrast to the lack of

effect of baf A1 upon Aβ production in K695 cells, treatment with FCCP for 4 hours

clearly inhibited Aβ production in a concentration-dependent manner. Moreover, in

10   contrast to the modest effects of FCCP upon APPsα release from K695sw cells,

treatment of K695 cells with FCCP for 4 hours also resulted in a marked concentration-

dependent decrease in APPsα production. The effect of FCCP upon Aβ and APPsα

production did not appear to be secondary to effects upon protein maturation, as the both

total levels of cellular APP as well as maturation of APP were unaffected (Fig. 4C).

15   Because of the low levels of C100 found in K695 cells, we were unable to quantify the

effects of FCCP upon this APP catabolic fragment. FIG. 4 illlustrates the effect of

FCCP exposure at various concentrations for 4 hours and cellular and released APP

catabolic fragments quantified by Western blot analysis. The effect of FCCP on A) Aβ

release, B) cellular C100, and C) total cellular APP are illustrated. In C) solid, white

20   and hatched bars represent total, mature and immature APP, respectively. Data

represent mean ± SEM with * p < 0.05.

FCCP does not Inhibit ATP Formation and is Not Toxic

     Since mitochondria utilize the proton gradient as a driving force for ATP

generation, it has long been thought that FCCP and the class of mobile ionophores of

25   which it is a member uncouple oxidative phosphorylation (37, 38). Indeed, it has been

shown that 1 µM FCCP is sufficient to alter mitochondrial membrane potential (39) and

that application of 30 µM FCCP for 2 hours is sufficient to modestly decrease cellular

ATP levels (40). To determine whether the concentrations of FCCP which altered APP

catabolism were sufficient to change ATP levels in K695sw cells, we measured ATP

30   levels following exposure of these cells to various concentrations of FCCP (Fig. 5A). As

a positive control, the effects of a combination treatment with NaA/DG on cellular ATP

levels was also evaluated (Fig. 5B). As expected, treatment of K695sw cells with

NaA/DG resulted in concentration- and time-dependent decreases in cellular ATP levels.

However, treatment of cells with FCCP did not alter cellular ATP levels at any of the

5   concentrations or time points measured. FIG. 5 illlustrates the effect of FCCP exposure

at various concentrations for either 30 minutes (shaded) or 4 hours (solid) and cellular

ATP levels quantitated by lucifern/luciferase bioluminescence assay (A). As a positive

control, the ability of NaA/DG to deplete cellular ATP levels can be seen in (B). Data

represent mean ± SEM with * $p < 0.05$.

10   As a further measure to ensure that the effects of FCCP were not due to altering

the integrity of K695sw cells, we employed YO-PRO exclusion staining as a measure of

cell viability. As can be seen in FIG. 6, even following 24 hours of exposure to FCCP,

there was no increase in cell death as measured by membrane exclusion. Taken

together, these data suggest that the effects of FCCP upon APP catabolism are

15   independent of effects upon oxidative phosphorylation, and that concentrations of FCCP

which markedly alter APP catabolism are not overtly toxic. FIG. 6 illustrates K695

exposure to vehicle (circles), 5 μM (squares), 500 nM (diamonds) or 50 nM (hexagons)

FCCP for 24 hrs and cell viability assessed by the YO-PRO exclusion method. At the

end of the experiment, 0.1% Triton X-100 was added to each well as a positive control.

20   Data represent mean ± SEM with * $p < 0.05$.

FCCP does not Alter Endosomal Function and Effects Lysosomal Function Less than

Bafilomycin A1 and NH₄Cl

            Based on the lack of effect of FCCP on cellular ATP levels we sought to

ascertain the specific acidic compartment(s) through which deacidification by FCCP

25   could account for a decrease in APP catabolism. Endosomal function was assessed by

the receptor-mediated uptake of both Tf-Tx and Tf-F, which are non- and pH-sensitive

endosomal probes, respectively. The use of these probes to measure endosomal function

has been well characterized (33-35) and the pH-dependency of the Tf-F signal is based

on the known sensitivity of fluoroscein to low pH whereby its fluorescent signal is

30   deminished. Thus, decreases in Tf-Tx uptake represent decreased receptor-mediated

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internalization of transferrin and/or total endosomal number whereas increases in Tf-F fluorescence may be indicative of endosomal deacidification. However, a confounding complication with the use of Tf-F to quantitate endosomal pH is the fact that decreased tranferrin uptake or endosomal number will inherently decrease the Tf-F signal which

5   makes relative increases in fluorescence due to endosomal deacidification more difficult to quantitate. Despite this, it was observed that in contrast to treatment with both baf A1 and NH_4Cl, FCCP did not significantly alter endosomal functioning (Fig. 7A). The decreases in both Tf-Tx and Tf-F signals observed following treatment with baf A1 and NH_4Cl indicate that these agents are able to impair endosomal function by

10   approximately 50% at the concentrations employed. FIG. 7 illustrates illustrates K695 exposure to vehicle, FCCP (5 μM and 500nM), baf A1 (1 μM) and NH_4Cl (20 mM) for 4 hrs and endosomal and lysosomal functioning assessed. Endosomal function was evaluated by the fluorescent quantitation of both the non-pH-dependent probe, Tf-Tx (shaded), and the pH-sensititive conjugate, Tf-F (solid) **(A)**. Similarly, lysosomal

15   function was measured by the fluorescent quantitation of both the blue (shaded) and yellow (solid) emission spectras of Lysosensor™ which are more predominant in less and more acidic lysosomes, respectively **(B)**. Data represent mean ± SEM with * p < 0.05.

         Through the use of a similar technique, putative lysosomal function was assessed

20   by the quantitation of Lysosensor™ Yellow/Blue DND-160 uptake. In an analogous way as with the transferrin conjugates, overall lysosomal number and pH can be quantitated with this probe which exhibits a predominantly blue fluorescent emission spectra in less acidic lysosomes and a yellow emission spectra which increases upon acidification. Although it is probable that proportion of this probe may also partition

25   into other acidic compartments, it is thought that Lysosensor™ predominantly accumulates in lysosomes of somatic cells and its staining pattern has been reported to resemble that of markers for lysosomes (LAMP-1 and 2)(36). A slight drawback with this technique is the presence of a small amount of overlap between the excitation and emission spectra which are originating from the same parent molecule. However, as

30   with the effects of baf A1 and NH_4Cl on endosomal function it was observed that both

of these agents produced profound reductions in lysosomal functioning (Fig. 7B).
Interestingly, FCCP also led to reductions in lysosomal function, albeit not as profound
as those observed with baf A1 or NH_4Cl.

5   The abbreviations used hereinabove are: **AD**, Alzheimer's Disease; **Aβ**, amyloid
β peptide; **APP**, amyloid precursor protein; **APPsα**, α-secretase cleaved N-terminal
ectodomain of APP; **baf A1**, bafilomycin A1; **C100**, C-terminal fragment containing the
amyloid-β sequence; **DG**, 2-deoxy-D-glucose; **DMEM**, Dulbecco's modified Eagle's
medium; **FCCP**, carbonyl cyanide *p*-(trifluoromethoxy)phenylhydrazone; **NaA**, sodium
azide; **PBS**, phosphate-buffered saline; **SDS-PAGE**, sodium dodecyl sulfate-
10   polyacrylamide gel electrophoresis.

It will be understood that the particular embodiments of the invention are shown
by illustration and not as limitations of the invention. The principal features of the
invention can be employed in various embodiments without departing from the scope of
the present invention. All parts and percentages are by weight unless otherwise stated.

15

Equivalents

Those skilled in the art will know, or be able to ascertain, using no more than
routine experimentation, many equivalents to the specific embodiments of the invention
described herein. These and all other equivalents are intended to be encompassed by the
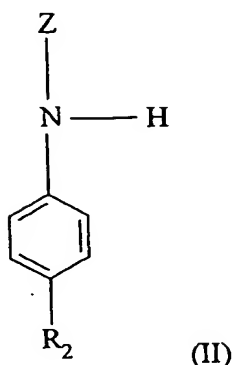20   following claims.

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What is claimed is:

1.   A method of modulating APP catabolism, comprising the step of administering
        to APP-containing cells an amount of a mobile ionophore composition effective

5   to modulate APP catabolism without substantially altering the viability of said
        APP-containing cells.

2.   The method of claim 1 wherein said mobile ionophore composition is of the
        formula

10   [Y-]-NH-[-Z]   (I)
        wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H, an alkyl
        group, an alkoxy group, or an electron-withdrawing moiety; provided that when
        Z is H, Y further comprises an electron-withdrawing moiety thereon.

15   3.   The method of claim 2 wherein Y is selected from the group consisting of aryl,
        aralkyl, aryl heterocycles, polycycyls, and heterocyclyls.

4.   The method of claim 2 wherein Y is selected from the group consisting of
        benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole,

20·   pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, naphthyl, quinolyl,
        indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine,
        morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones.

5.   The method of claim 1 wherein said mobile ionophore composition is of the formula:

$$
\begin{array}{c}
Z \\
| \\
N \!-\!\! H \\
| \\
\end{array}
$$

(II)

wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety.

6.   The method of claim 5 wherein Z and R_2 are electron-withdrawing moieties.

7.   The method of claim 1 wherein said electron-withdrawing moieties are selected from the group consisting of trifluoromethanesulfonyl, trifluoromethoxy, trifluoroethoxy, and carbonyl cyano groups.

8.   The method of claim 5 wherein R_2 is an alkoxy group which contains one or more halogen atoms thereon.

9.   The method of claim 5 wherein R_2 is a mono-, di-, or tri- halomethoxy group.

10.   The method of claim 5 wherein R_2 is a trifluoromethoxy group and Z is - $NC(CN)_2$.

11.   The method of claim 10 wherein Z is -SO_2R_4 where R_4 is a mono-, di- or tri- halomethyl group.

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12.   The method of claim 1 wherein said mobile ionophore composition is selected
        from the group consisting of carbonyl cyanide *p*-(trifluoromethoxy)
        phenylhydrazone, carbonyl cyanide *m*-chlorophenylhydrazone, *N*[4-
        (tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-
5   chlorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-
        (tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-
        (methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*t*-butyl)phenyl]-
        1,1,1-trifluoromethanesulfonamide, *N*-[4-fluorophenyl]-1,1,1-
        trifluoromethanesulfonamide, *N*-phenyl-1,1,1-trifluoromethanesulfonamide, *N*-
10   [4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*N,N*-
        dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-cyanophenyl]-
        1,1,1-trifluoromethanesulfonamide, and *N*-[4-(methylsulfonyl)phenyl]-1,1,1-
        trifluoromethanesulfonamide.

15 13.   A method of treating Alzheimer's disease, comprising the step of administering
        to a subject having APP-containing cells a pharmaceutically effective amount of
        a mobile ionophore composition effective to modulate APP catabolism without
        substantially altering the viability of said APP-containing cells, such that said
        disease is treated.

20

    14.   The method of claim 13 wherein said mobile ionophore composition is of the
        formula

                                [Y-]-NH-[-Z]   (I)

        wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H, an alkyl
25   group, an alkoxy group, or an electron-withdrawing moiety; provided that when
        Z is H, Y further comprises an electron-withdrawing moiety thereon.

    15.   The method of claim 13 wherein Y is selected from the group consisting of aryl,
        aralkyl, aryl heterocycles, polycycyls, and heterocyclyls.

30

16.   The method of claim 13 wherein Y is selected from the group consisting of
benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole,
pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, naphthyl, quinolyl,
indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine,
morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones.

17.   The method of claim 13 wherein said mobile ionophore composition is of the
formula:
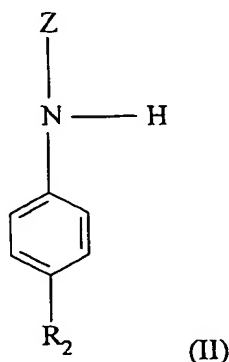
$$
\begin{array}{c}
Z \\
| \\
N \text{---} H \\
| \\
\bigcirc \\
| \\
R_2
\end{array}
\qquad (II)
$$

wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing
moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing
moiety.

18.   The method of claim 17 wherein Z and R_2 are electron-withdrawing moieties.

19.   The method of claim 13 wherein said electron-withdrawing moieties are selected
from the group consisting of trifluoromethanesulfonyl, trifluoromethoxy,
trifluoroethoxy, and carbonyl cyano groups.

20.   The method of claim 17 wherein R_2 is an alkoxy group which contains one or
more halogen atoms thereon.

21.   The method of claim 17 wherein R_2 is a mono-, di-, or tri- halomethoxy group.

22.   The method of claim 17 wherein R_2 is a trifluoromethoxy group and Z is -NC(CN)$_2$.

23.   The method of claim 17 wherein Z is -SO$_2$R$_4$ where R$_4$ is a mono-, di- or tri-
halomethyl group.

24.   The method of claim 13 wherein said mobile ionophore composition is selected
from the group consisting of carbonyl cyanide p-(trifluoromethoxy)
phenylhydrazone, carbonyl cyanide m-chlorophenylhydrazone, N[4-
(tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-
chlorophenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-
(tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-
(methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-(t-butyl)phenyl]-
1,1,1-trifluoromethanesulfonamide, N-[4-fluorophenyl]-1,1,1-
trifluoromethanesulfonamide, N-phenyl-1,1,1-trifluoromethanesulfonamide, N-
[4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-(N,N-
dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, N-[4-cyanophenyl]-
1,1,1-trifluoromethanesulfonamide, and N-[4-(methylsulfonyl)phenyl]-1,1,1-
trifluoromethanesulfonamide.

25.   The method of claim 24 wherein said modulation of said APP catabolism results
in a decrease in amyloid deposition.

26.   The method of claim 24 wherein said modulation of said APP catabolism results
in a reduction in extracellular plaques.

27.   A method of treating a disease state associated with amyloidosis, comprising the
step of administering to a subject having APP-containing cells a
pharmaceutically effective amount of a mobile ionophore composition effective
to modulate APP catabolism without substantially altering the viability of said
APP-containing cells.

28.   The method of claim 27 wherein said mobile ionophore composition is of the formula
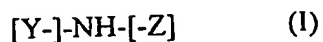
$$[Y-]-NH-[-Z] \qquad (I)$$

wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; provided that when Z is H, Y further comprises an electron-withdrawing moiety thereon.

29.   The method of claim 28 wherein Y is selected from the group consisting of aryl, aralkyl, aryl heterocycles, polycycyls, and heterocyclyls.

30.   The method of claim 28 wherein Y is selected from the group consisting of benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole, pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, naphthyl, quinolyl, indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine, morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones.

31.   The method of claim 27 wherein said mobile ionophore composition is of the formula:
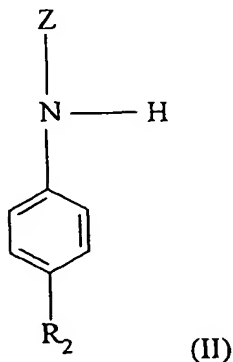
(II)

wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety.

32.   The method of claim 31 wherein Z and R_2 are electron-withdrawing moieties.

33.   The method of claim 27 wherein said electron-withdrawing moieties are selected from the group consisting of trifluoromethanesulfonyl, trifluoromethoxy, trifluoroethoxy, and carbonyl cyano groups.

34.   The method of claim 31 wherein R_2 is an alkoxy group which contains one or more halogen atoms thereon.

35.   The method of claim 31 wherein R_2 is a mono-, di-, or tri- halomethoxy group.

36.   The method of claim 31 wherein R_2 is a trifluoromethoxy group and Z is -$NC(CN)_2$.

37.   The method of claim 31 wherein Z is -SO_2R_4 where R_4 is a mono-, di- or tri-halomethyl group.

38.   The method of claim 27 wherein said mobile ionophore composition is selected from the group consisting of carbonyl cyanide *p*-(trifluoromethoxy) phenylhydrazone, carbonyl cyanide *m*-chlorophenylhydrazone, *N*[4-(tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-chlorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*t*-butyl)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-fluorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-phenyl-1,1,1-trifluoromethanesulfonamide, *N*-[4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*N*,*N*-dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-cyanophenyl]-1,1,1-trifluoromethanesulfonamide, and *N*-[4-(methylsulfonyl)phenyl]-1,1,1-trifluoromethanesulfonamide.

39.   The method of claim 27 wherein said modulation of said APP catabolism results in a decrease in amyloid deposition.

40.   The method of claim 27 wherein said modulation of said APP catabolism results
5   in a reduction in extracellular plaques.

41.   A pharmaceutical composition for treating a disease state associated with amyloidosis, comprising a therapeutically effective amount of a mobile ionophore composition effective to modulate APP catabolism in APP-containing
10   cells without substantially altering the viability of said APP-containing cells, and a pharmaceutically acceptable vehicle.

42.   The pharmaceutical composition of claim 41 wherein said mobile ionophore composition is of the formula
15   [Y-]-NH-[-Z]   (I)
        wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; provided that when Z is H, Y further comprises an electron-withdrawing moiety thereon.

20   43.   The pharmaceutical composition of claim 42 wherein Y is selected from the group consisting of aryl, aralkyl, aryl heterocycles, polycycyls, and heterocyclyls.

44.   The pharmaceutical composition of claim 42 wherein Y is selected from the
25   group consisting of benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole, pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, naphthyl, quinolyl, indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine, morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones.

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45.   The pharmaceutical composition of claim 41 wherein said mobile ionophore
        composition is of the formula:

$$
\begin{array}{c}
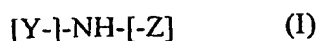Z \\
| \\
N \!\!-\!\!-\!\! H \\
| \\
\end{array}
$$

(II)
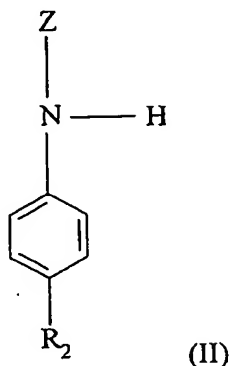
wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing
moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing
moiety.

46.   The pharmaceutical composition of claim 45 wherein Z and R_2 are electron-
        withdrawing moieties.

47.   The pharmaceutical composition of claim 41 wherein said electron-withdrawing
        moieties are selected from the group consisting of trifluoromethanesulfonyl,
        trifluoromethoxy, trifluoroethoxy, and carbonyl cyano groups.

48.   The pharmaceutical composition of claim 45 wherein R_2 is an alkoxy group
        which contains one or more halogen atoms thereon.

49.   The pharmaceutical composition of claim 45 wherein R_2 is a mono-, di-, or tri-
        halomethoxy group.

50.   The pharmaceutical composition of claim 45 wherein R_2 is a trifluoromethoxy
        group and Z is $-NC(CN)_2$.

51.   The pharmaceutical composition of claim 45 wherein Z is $-SO_2R_4$ where R_4 is a
        mono-, di- or tri- halomethyl group.

52. The pharmaceutical composition of claim 41 wherein said mobile ionophore composition is selected from the group consisting of carbonyl cyanide *p*-(trifluoromethoxy) phenylhydrazone, carbonyl cyanide *m*-chlorophenylhydrazone, *N*[4-(tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-chlorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*t*-butyl)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-fluorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-phenyl-1,1,1-trifluoromethanesulfonamide, *N*-[4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*N,N*-dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-cyanophenyl]-1,1,1-trifluoromethanesulfonamide, and *N*-[4-(methylsulfonyl)phenyl]-1,1,1-trifluoromethanesulfonamide.

53. A method for modulating amyloid deposition in a subject, comprising administering to a subject having APP-containing cells an effective amount of a of a mobile ionophore composition effective to modulate APP catabolism without substantially altering the viability of said APP-containing cells, such that modulation of amyloid deposition occurs.

54.   The method of claim 53 wherein said mobile ionophore composition is of the formula

$$[Y-]-NH-[-Z] \qquad (I)$$

wherein Y is a hydrophobic/lipophilic moiety; N is nitrogen; and Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; provided that when Z is H, Y further comprises an electron-withdrawing moiety thereon.

55.   The method of claim 54 wherein Y is selected from the group consisting of aryl, aralkyl, aryl heterocycles, polycycyls, and heterocyclyls.

56.   The method of claim 54 wherein Y is selected from the group consisting of benzene, pyrrole, furan, thiophene, imidazole, oxazole, thiazole, triazole, pyrazole, pyridine, pyrazine, pyridazine and pyrimidine, naphthyl, quinolyl, indolyl, tetralin, pyrrolidine, oxolane, thiolane, oxazole, piperidine, piperazine, morpholine, lactones, lactams, pyrrolidinones, lactones, sultams, and sultones.

57.   The method of claim 53 wherein said mobile ionophore composition is of the formula:
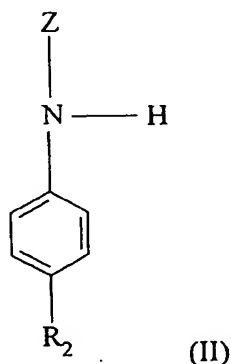
(II)

wherein R_2 is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety; Z is H, an alkyl group, an alkoxy group, or an electron-withdrawing moiety.

58.   The method of claim 57 wherein Z and R_2 are electron-withdrawing moieties.

59.   The method of claim 53 wherein said electron-withdrawing moieties are selected from the group consisting of trifluoromethanesulfonyl, trifluoromethoxy, trifluoroethoxy, and carbonyl cyano groups.

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60.   The method of claim 57 wherein R_2 is an alkoxy group which contains one or more halogen atoms thereon.

61.   The method of claim 57 wherein R_2 is a mono-, di-, or tri- halomethoxy group.

10

62.   The method of claim 57 wherein R_2 is a trifluoromethoxy group and Z is - $NC(CN)_2$.

63.   The method of claim 57 wherein Z is $-SO_2R_4$ where R_4 is a mono-, di- or tri-

15   halomethyl group.

64.   The method of claim 53 wherein said mobile ionophore composition is selected from the group consisting of carbonyl cyanide *p*-(trifluoromethoxy) phenylhydrazone, carbonyl cyanide *m*-chlorophenylhydrazone, *N*[4-

20   (tetrafluoroethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-chlorophenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(tetrafluoromethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(methylthio)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*t*-butyl)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-fluorophenyl]-1,1,1-

25   trifluoromethanesulfonamide, *N*-phenyl-1,1,1-trifluoromethanesulfonamide, *N*-[4-(ethoxy)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-(*N,N*-dimethylamino)phenyl]-1,1,1-trifluoromethanesulfonamide, *N*-[4-cyanophenyl]-1,1,1-trifluoromethanesulfonamide, and *N*-[4-(methylsulfonyl)phenyl]-1,1,1-trifluoromethanesulfonamide.

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FIG. 1A

FIG. 1B

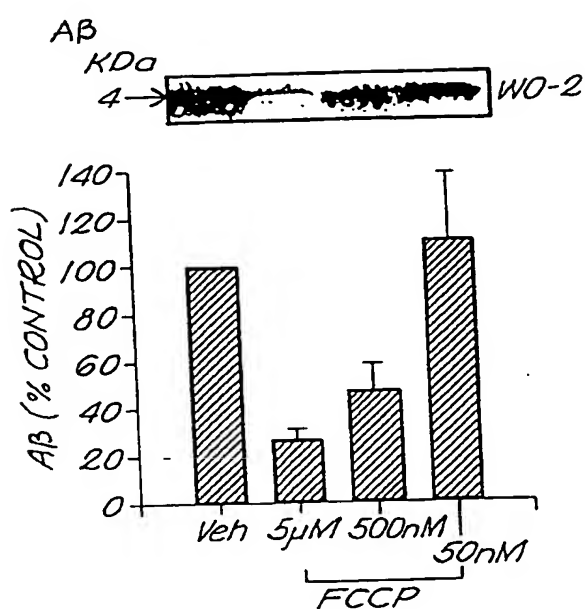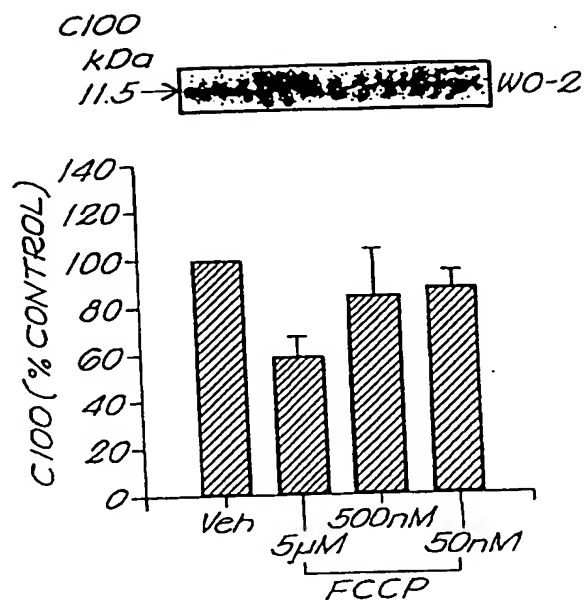**FIG. 2A**

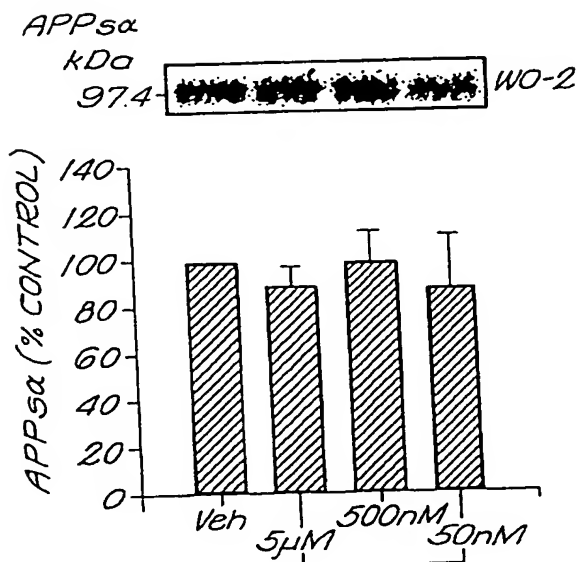**FIG. 2B**

FIG. 2C

FIG. 2D

SUBSTITUTE SHEET (RULE 26)

Aβ
kDa
4→   WO-2

FIG. 3A

C100
kDa
11.5→   WO-2

FIG. 3B

APPsα
kDa
97.4   WO-2

FIG. 3C

APP
kDa
97.4   22C11

FIG. 3D

Aβ   4/7

FIG. 4A

FIG. 4B

FIG. 4C

FIG. 5A

FIG. 5B

FIG. 6

FIG. 7A

FIG. 7B

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   A61K31/63   A61K31/15   A61K31/135

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 00746 A (ALZA CORPORATION) 23 January 1992 (1992-01-23) claims 1,3,12,14,15,24 ---	41-47,52
X	WO 92 02234 A (ALZA CORPORATION) 20 February 1992 (1992-02-20) claims 1-4,9-11,18-20,25,26 page 7, line 15 – line 22 ---	41-47,52
A	WO 92 14456 A (H. SHAPIRO) 3 September 1992 (1992-09-03) claims 1,2,31 ---	1-64
A	WO 95 21612 A (NPS PHARMACEUTICALS INC.) 17 August 1995 (1995-08-17) claims 7-19 page 20, line 18 – page 21, line 11 ---	1-64

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 September 1999	22/09/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl. Fax: (+31–70) 340–3016	Siatou, E

1

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE CHEMABS 'Online! CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US TAMAI, IKUMI ET AL: "Proton -cotrasport of pravastatin across intestinal brush-border membrane" retrieved from STN Database accession no. 124:44716 HCA XP002114450 abstract & PHARM. RES. (1995), 12(11), 1727-32 , -----	1-64

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

1

.rnational application No.

PCT/US 99/ 10681

Box I   Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X]   Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

   Remark: Although claims 1-40 and 53-64
   are directed to a method of treatment of the human/animal
   body, the search has been carried out and based on the alleged
   effects of the compound/composition.

2. [X]   Claims Nos.:
   because they relate to parts of the International Application that do not comply with the prescribed requirements to such
   an extent that no meaningful International Search can be carried out, specifically:

   Claims Nos. 1-9, 13-21, 27-35, 41-49, 53-61
   see FURTHER INFORMATION sheet PCT/ISA/210

3. [ ]   Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II   Observations where unity of Invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ]   As all required additional search fees were timely paid by the applicant, this International Search Report covers all
   searchable claims.

2. [ ]   As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment
   of any additional fee.

3. [ ]   As only some of the required additional search fees were timely paid by the applicant, this International Search Report
   covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ]   No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is
   restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ]   The additional search fees were accompanied by the applicant's protest.

[ ]   No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1998)

FURTHER INFORMATION CONTINUED FROM   PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.:   1-9 13-21 27-35 41-49 53-61

Present claims 1-9, 13-21, 27-35, 41-49, 53-61 relate to an extremely large number of possible compounds and their use in treating amyloid deposition. In fact, the claims contain so many variables that a lack of clarity (and/or conciseness) within the meaning of Article 6 PCT arises to such an extent as to render a meaningful search of the claims impossible. Consequently, the search has been carried out for those parts of the application which do appear to be clear (and/or concise), namely the compounds listed in claims 10-12 as well as to pharmaceutical compositions and uses thereof.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

International Application No

PC1/US 99/10681

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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			AU	641787 B	30-09-1993
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			JP	9509484 T	22-09-1997

Form PCT/ISA/210 (patent family annex) (July 1992)